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BENTHIC FISHES CAST ASHORE BY GIANT WAVES NEAR POINT JOE, MONTEREY COUNTY, CALIFORNIA

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INTRODUCTION

In the vicinity of Point Joe, Monterey County, California, on the morning of February 9, 1960, giant waves driven by winds of gale force cast ashore a number of fishes that normally inhabit one or more zones of the benthic environment.

The powerful winds, which for three days battered the California coast from Humboldt County to San Luis Obispo County, generated waves up to 40 feet in height,[1] causing extensive damage along the shoreline of the Monterey Peninsula. More than 50 boulders were cast onto or across the Seventeen Mile Drive near Point Joe (these were shown in photographs published on the front page of the Monterey Peninsula Herald, February 9, 1960). An automobile being driven along the Seventeen Mile Drive near Point Joe was picked up by a wave and moved about 150 feet. The Seventeen Mile Drive was partly torn out north of Cypress Point. A huge wave entered a third-story window of a waterfront hotel at Cannery Row, Monterey. A 300-foot pier and its boathouse were destroyed at Stillwater Cove.

Suspecting that fishes might have been cast ashore by these enormous waves, Miss E. Eugenia Patten and Miss Priscilla J. Ferguson, of Carmel, California, immediately began to search the region south of Point Joe, and continued their search of that area from February 9 to February 24, 1960. By their assiduous

[1] No tsunami is known to have occurred in the eastern Pacific during February 1960. See Talley and Cloud (1960, p. 36).

Figure 1. Offshore view of area where benthic fishes were cast ashore, showing logs that giant waves deposited over the channel of the intermittent stream. Photograph by E. Eugenia Patten, February 1960.

efforts, they collected 36 fishes cast ashore by this storm, all but one of which represent species that have been recorded from the outer sublittoral zone (depths from about 50 to 200 meters; see Zonation, p. 482).

The relatively flat unforested area where these fishes were cast ashore is approximately 0.9 mile (by road) southward from Point Joe. It extends for some 90 yards in a northerly and southerly direction between the shoreline and the Seventeen Mile Drive, and varies in width from 20 to 25 yards. This area slopes gently toward the ocean, terminating at the top of an irregular bluff about 10 feet above normal high water. The narrow channel of a short intermittent stream which enters the Pacific Ocean at 36°35′47″ N., 121°57′37″ W. (see Monterey Sheet 1657 III SW, Army Map Service Series V895), crosses the area from east to west. (From the stream, the area extends some 75 yards northward and 15 yards southward.) An offshore view of this area (fig. 1) shows several logs that the giant waves deposited over the channel of the intermittent stream; an inshore view (fig. 2) shows a number of boulders that the waves cast ashore and lodged in two branches of the stream.

The locality where these fishes were cast ashore is about four miles (by road) from Stillwater Cove, where thousands of blue lanternfish, *Tarletonbeania crenularis* (Jordan and Gilbert), were found dead on October 17, 1952, along some 200 yards of beach, at the high-tide level. The mass stranding of that bathypelagic species may have been caused by attacking predators, since it occurred during

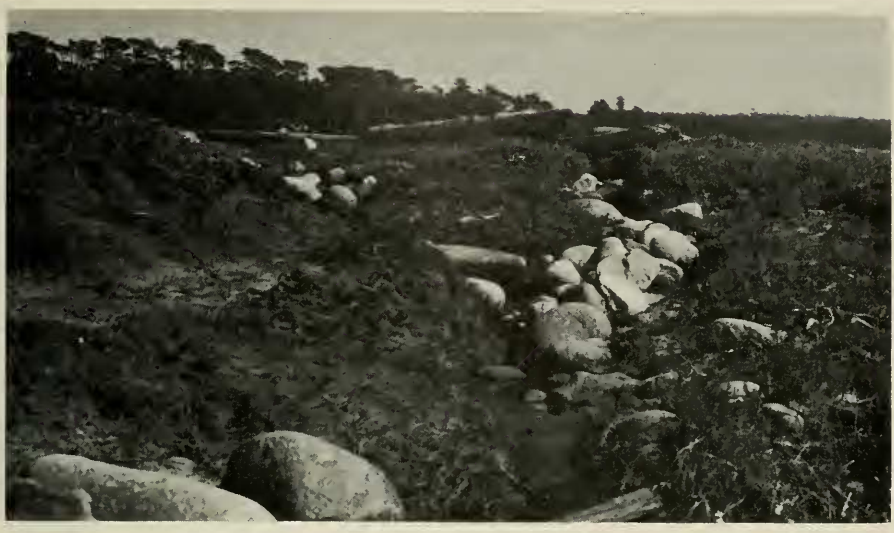

Figure 2. Inshore view of area where benthic fishes were cast ashore, showing boulders that giant waves lodged in two branches of the intermittent stream. Photograph by E. Eugenia Patten, February 1960.

clear weather, with only a slight wind and less than one-foot surf action (Aughtry, 1953, p. 190).

FISHES REPRESENTED

The collection comprises 36 fishes, representing seven species, five genera, and five families:

Family Embiotocidae—Surfperches

Micrometrus aurora (Jordan and Gilbert)—reef perch

Family Scorpaenidae—Scorpionfishes

Sebastes flavidus (Ayres)—yellowtail rockfish
Sebastes rosaceus Girard—rosy rockfish
Sebastes helvomaculatus Ayres—rosethorn rockfish

Family Gobiidae—Gobies

Coryphopterus nicholsii (Bean)—blackeye goby

Family Brotulidae—Brotulas

Brosmophycis marginata (Ayres)—red brotula

Family Ophidiidae—Cusk-eels

Chilara taylori (Girard)—spotted cusk-eel

DISCUSSION

The meristic data were taken from radiographs, and are expressed as by Hubbs and Lagler (1958). The abbreviation "CAS" precedes a catalog number of the Department of Ichthyology of the California Academy of Sciences.

Family Embiotocidae—Surfperches

Micrometrus aurora (Jordan and Gilbert).

The reef perch (see Tarp, 1952, fig. 31), was originally described from 15 examples "taken in the bay of Monterey, and purchased by us in the San Francisco market" (Jordan and Gilbert, 1880, p. 299, as *Abeona aurora*).

Micrometrus aurora ranges from Tomales Bay, Marin County, California (Tarp, 1952, p. 86), to the first point south of the mouth of Río San Telmo, Baja California (CAS 27142). The specimens from the vicinity of Río San Telmo represent an extension of the recorded range from the southernmost locality noted by Tarp (1952, p. 86: 1¼ miles south of the mouth of Río San Isidro).

This species has been recorded from Point Pinos (Jordan and Gilbert, 1881, p. 51), which is about 2½ miles generally northward from Point Joe.

According to Hubbs (1921a, p. 183, as *Amphigonopterus aurora*), this species is restricted to the reefs, and commonly lives and breeds in the pools and channels of medium tidal height, particularly those that are largely open, free of eelgrass and algae, and floored with sand. Its habitat differs widely from that usual for the other species of this family, most of which live in the surf along sandy beaches, or in sheltered bays.

The reef perch attains a standard length of 141 mm. (Hubbs, 1921a, p. 201).

Material. One specimen (small adult), standard length 74 mm., CAS 26760. The characters and meristic data are in accord with those noted by Tarp (1952, p. 84).

Family Scorpaenidae—Scorpionfishes

I concur with Matsubara (1943, p. 178) in regarding *Sebastodes* Gill (1861, p. 165) as a subgenus of *Sebastes* Cuvier (1829, p. 166).

The vernacular "rockcod" for the species of this genus was criticized more than a century ago by Ayres (1854–1855, p. 94): "They are taken in rocky localities along the coast and in the Bay of San Francisco, and the title Rock Fish applies to them very well. One more inappropriate, on the contrary, than that of Rock Cod, could scarcely have been selected, inasmuch as they are very widely removed from the family in which the Codfishes are classed." Nevertheless "rockcod" still persists among sportsmen and commerical fishermen. Because of the extent of this popular usage, "rockcod" may eventually be recognized as the "official" vernacular despite its impropriety—as was the vernacular "lingcod" for *Ophiodon elongatus* Girard, also widely removed from the cods.

Sebastes flavidus (Ayres).

The yellowtail rockfish (see Phillips, 1957, fig. 17) was originally described from the San Francisco market (Ayres, 1863, p. 209, fig. 64).

Sebastes flavidus ranges from the vicinity of Forrester Island, Alaska (Westrheim, 1966, p. 1469), to San Diego, California (Phillips, 1964, p. 28).

The yellowtail rockfish occurs over reefs, especially in depths greater than 15 m. (50 feet), and also over deep sand and mud bottoms to depths of 183 m. (100 fathoms), but it is usually found at depths between 24 m. and 46 m. (between 13 and 25 fathoms), according to Odemar, Wild, and Wilson (1968, p. 126). The young do not normally inhabit the tide-pools (Hubbs and Schultz, 1933, pp. 20, 21). I collected a young specimen (standard length 62 mm., CAS 25897) from the Monterey municipal wharf in 4.9 m. Specimens have been recorded from Cordell Bank, Marin County, California, in 51 m. to 72 m. (Follett, 1952, p. 415; "28 to 40 fathoms"); from Baynes Sound, British Columbia, in 55 m. to 72 m. (Clemens and Wilby, 1961, p. 254; "30 to 40 fathoms"); from the southern edge of Astoria Canyon, Oregon, in 110 m. to 133 m. (Pereyra, Pearcy, and Carvey, 1969, p. 2211; "60–73 fath"). It has been taken in depths of 187 m. to 194 m. (Westrheim, 1966, p. 1469) and 366 m. or more (Alverson, Pruter, and Ronholt, 1964, fig. 43; "200–299 fathoms").

The yellowtail rockfish attains a length of 66 cm. (Phillips, 1957, p. 56; Clemens and Wilby, 1961, p. 253; Miller and Gotshall, 1965, p. 117; "26 inches"), as determined from Canadian specimens (see Phillips, 1968, Appendix A-5). The maximum length recorded from California is about 58 cm. (Phillips, 1964, pp. 19, 28; "23 inches").

Material. One specimen (young), standard length 73 mm., CAS 26761. The characters and meristic data are in accord with those noted by Phillips (1957, p. 57; 1964, p. 28).

Sebastes rosaceus Girard.

The rosy rockfish (see Phillips, 1957, fig. 47), was originally described from San Diego, California (Girard, 1854, p. 146).

Sebastes rosaceus ranges from Cordell Bank, Marin County, California (Follett, 1952, p. 417), to Turtle Bay, Baja California (Phillips, 1957, p. 116). Records from farther north than Cordell Bank appear to have been based on misidentified specimens of *S. helvomaculatus* (Lo-chai Chen, personal correspondence, January 20, 1970).

This species has been recorded from reefs in and near Monterey Bay, California, in less than 15 m. to more than 46 m. (Miller, Odemar, and Gotshall, 1967, pp. 95, 96, 102, 103; "less than 50 feet to more than 150 feet"); from Cordell Bank, Marin County, California, in 51 m. to 62 m. (Follett, 1952, p. 417; "28 to 34 fathoms"); from off San Nicolas Island, California, in 58 m. to 60 m.

(Gilbert, 1915, p. 336; "32–33 fathoms"). It has been taken at depths as great as 130 m. to 140 m. (Lo-chai Chen, personal correspondence, December 1, 1969).

The rosy rockfish attains a length of 36 cm. (Miller and Gotshall, 1965, p. 116; "14.2 inches").

Material. Four specimens (young), standard length 53 mm. to 67 mm., CAS 26762; identification confirmed by Lo-chai Chen. Four other specimens, standard length 37 mm. to 60 mm., may represent *Sebastes rosaceus*, but they have not been identified with certainty.

Sebastes helvomaculatus Ayres.

The rosethorn rockfish (see Phillips, 1957, fig. 48) was long ago described by Ayres (1859, p. 26, fig. 8), from a specimen obtained in the San Francisco market. However, this species was for nearly a century thereafter relegated to the synonymy of *Sebastes rosaceus* Girard—as by Gill (1864, p. 147), Jordan and Gilbert (1883, p. 667), Eigenmann and Beeson (1894, p. 395), Jordan and Evermann (1898a, p. 1808), and Jordan, Evermann, and Clark (1930, p. 367). The distinctive coloration of this species was noted by Carl L. Hubbs (personal communication). Later, Phillips (1957, pp. 30, 31, 118, 119) noted (in addition to the coloration) distinctive morphometric characters, which, however, were considered inadequate by Heyamoto and Hitz (1962, p. 848) and by Westrheim (1965, p. 232).

Sebastes helvomaculatus ranges from the Gulf of Alaska (Westrheim, 1965, p. 232) to Guadalupe Island, Baja California (Phillips, 1957, p. 118).

This species has been recorded from depths of 133 m. (Westrheim, 1965, p. 232; "73 fathoms") to 457 m. (Heyamoto and Hitz, 1962, p. 848; "250 fathoms").

The rosethorn rockfish attains a length of 33 cm. (Phillips, 1957, p. 118; "13 inches").

Material. One specimen (large young), standard length 89 mm., CAS 27139; identified by Lo-chai Chen. One or more of the four small specimens noted under *Sebastes rosaceus* as not identified with certainty may represent *Sebastes helvomaculatus*.

Family Gobiidae—Gobies

Coryphopterus nicholsii (Bean).

The blackeye goby (see Barnhart, 1936, fig. 245, as *Rhinogobiops nicholsii;* see also Ebert and Turner, 1962, fig. 1), also called "bluespot goby" and "crested goby," was originally described from a specimen taken at Departure Bay, British Columbia, in 37 m. (Bean, 1882, p. 469, as *Gobius nicholsii;* "20 fathoms").

Coryphopterus nicholsii ranges from Skidegate Channel, Queen Charlotte Islands (Clemens and Wilby, 1961, p. 359), to San Martín Island, Baja California (Limbaugh, 1955, p. 120).

This species is generally known as an inshore, shallow-water, benthic inhabitant (Berry and Perkins, 1966, p. 676). According to Gilbert (1915, p. 359), this species "has also been taken in shallow water, but not between tides, at Monterey." Two specimens were collected within the littoral (intertidal) zone, by Rolf L. Bolin, on August 18, 1947, at a rocky point 0.5 mile south of Malpaso Creek, Monterey County. Using small pieces of prawn for bait, I collected with rod and line two specimens (Stanford Natural History Museum catalog nos. 35015 and 35016) on March 16, 1940, in San Francisco Bay, at a depth of 6 m., from the Van Ness Avenue pier, San Francisco. It has been recorded from off San Elijo Lagoon, San Diego County, in 12 m. and 18 m. (Turner, Ebert, and Given, 1965, p. 109; "40 feet and 60 feet"), and from off Hermosa Beach and Santa Monica in 18 m. (Ebert and Turner, 1962, p. 250; "60 feet"). Two specimens, standard length 36 mm. and 37 mm. (CAS 27140), were collected southwest of South Coronado Island, Baja California, in 18 m. to 25 m. It has been recorded from near Pacific Grove, California, in 18 m. or 27 m. (Snyder, 1913, p. 459; "10 or 15 fathoms"); from British Columbia at six localities—in depths of 37 m. or less (Clemens and Wilby, 1961, p. 359; "20 fathoms or less"); from Anacapa Passage, California (Jordan and Evermann, 1898b, p. 2218; "*Albatross* station 2944"), in 55 m. (see Tanner, 1892, p. 493; "30 fathoms"; see also U.S. Coast and Geodetic Survey Chart no. 5202, 1937); and from the vicinity of San Diego in 91 m. (Starks and Mann, 1911, p. 16, as *Rhinogobius nicholsii*; "50 fathoms"). Also, it has been reported as sometimes taken in more than 640 m. (Barnhart, 1936, p. 81; "2100 feet"). Its pelagic prejuvenile stages have been taken at depths of approximately 1,863 m. and 2,234 m. (Berry and Perkins, 1966, pp. 626, 627, 676).

The blackeye goby attains a length of about 15 cm. (Ebert and Turner, 1962, p. 250; "6 inches").

Material. Seven specimens (young to adult), standard length 33 mm. to 65 mm., CAS 26763. (The stomach of a 54-mm. specimen contained a gastropod, *Turbonilla* species, 2.8 mm. in length, identified by Allyn G. Smith.)

In all seven specimens, the sixth dorsal spine is remote from the fifth, and the attenuate, unsegmented first element of the second dorsal fin, as well as that of the anal fin, appears to represent a spine. So interpreted, the dorsal formula is VI–I,13 in four specimens and VI–I,12 in three; the anal formula is I,12 in three specimens and I,11 in four. There are 17 segmented caudal rays (counting both unbranched and branched rays) in six specimens. There are 2 unbranched segmented caudal rays above and 1 below in the three specimens in which these rays are discernible. The vertebral formula is $10 + 16 = 26$ in all seven specimens.

The interpretation of the first element of the second dorsal fin and of the anal fin as a spine is in accord with that of Hubbs (1943, p. 134), Ginsburg (1953, p. 18), and Böhlke and Robins (1960, p. 104). The dorsal, anal, and

vertebral counts are in accord with those of Clothier (1951, p. 73). The caudal-ray counts are in accord with those of Ginsburg (1945, pp. 136, 137).

Family Brotulidae—Brotulas

Pending further study of the ophidioids, I retain the family Brotulidae Swainson (1838, p. 317, as Brotulinae[2]) as distinct from the family Ophidiidae Bonaparte (1831, p. 38, as Ophididae[3]). On the basis of the otoliths, these two nominal families should not be merged according to John E. Fitch (personal communication, May 7, 1969).

Brosmophycis marginata (Ayres).

The red brotula (see Best, 1957, fig. 1), was originally described from a 305-mm. (12-inch) specimen collected more than a century ago near the entrance to San Francisco Bay (Ayres, 1854, p. 202, as *Brosmius marginatus*).

Brosmophycis marginata ranges from Petersburg, Alaska (Schultz and DeLacy, 1936, p. 142), at least to Ensenada, Baja California (Fitch, 1968, p. 24).

This species was recorded from Puget Sound by Gilbert and Thompson (1905, p. 985); from five other localities in Washington, by Schultz and DeLacy (1936, p. 142); and from British Columbia at four localities, including English Bay at 55 m. ("30 fathoms"), by Clemens and Wilby (1961, p. 394). Ten specimens, taken at seven localities along the coast of California, from off the mouth of the Klamath River to Ship Rock, Santa Catalina Island, in depths of 37 m. to 91 m., were recorded by Best (1957, p. 97; "120 to 300 feet"). It is said to occur mostly in depths of 18 m. to 122 m. (Fitch, 1968, p. 24; "60 to 400 feet").

A specimen deposited at the Cabrillo Marine Museum, San Pedro, California, was washed up in a severe storm on December 3, 1939, at Cabrillo Beach. Larvae have been collected north of Santa Catalina Island, California, and off El Descanso, Baja California (Ahlstrom, 1959, p. 110).

Selle (1924, p. 143) recorded a specimen from "90 miles south of Los Angeles Harbor." This record, published under the title "San Pedro Rarities," may constitute the basis for the statement by Jordan, Evermann, and Clark (1930, p. 479) that this species had been "recently taken at San Pedro, Calif." This "San Pedro" record was apparently accepted by Barnhart (1936, p. 92), Schultz (1936, p. 197), and Schultz and DeLacy (1936, p. 142).

The red brotula has been said to reach a length of nearly 46 cm. (Jordan and Gilbert, 1881, p. 65; "18 inches").

Material. Eleven specimens (large young to small adult), standard length 101 mm. to 250 mm., CAS 26764:

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[2] The priority of the name of a taxon in the family-group is not affected by elevation in rank within the group (International Code of Zoological Nomenclature, 1964, Article 23c).

[3] A family-group name of which the suffix is incorrect is available with its original date and authorship, but in properly emended form (International Code of Zoological Nomenclature, 1964, Article 11 (e) (ii).

Standard length (mm.)	*Dorsal rays*	*Anal rays*	*Caudal rays*	*Vertebrae*
101	101	73	16 (8 + 8)	16 + 48 = 64
103	99	76	16 (8 + 8)	17 + 47 = 64
107	101	75	16 (8 + 8)	16 + 47 = 63
112	101	74	16 (8 + 8)	16 + 48 = 64
119	101	75	16 (8 + 8)	16 + 48 = 64
130	104	74	16 (8 + 8)	16 + 49 = 65
133	105	81	16 (8 + 8)	16 + 48 = 64
149	—	76	16 (8 + 8)	16 + 49 = 65
165	104	75	16 (8 + 8)	16 + 48 = 64
216	—	73	16 (8 + 8)	16 + 48 = 64
250	110	77	17 (9 + 8)	16 + 49 = 65

The caudal-ray counts of 16 (8 + 8) in ten specimens and 17 (9 + 8) in one specimen suggest that *Brosmophycis marginata* normally has twice the number of caudal rays noted for two other brotulids known from California:

8 (4 + 4) in a specimen of *Cataetyx rubrirostris* Gilbert, standard length 60 mm. (CAS 27145), picked up at the drift-line on Moss Beach, Monterey County, California, on April 5, 1959, by Miss E. Eugenia Patten;

8 (4 + 4) in a specimen of *Cataetyx rubrirostris* collected off northern Oregon (Grinols and Greenfield, 1966, p. 212);

9 (5 + 4) in a specimen of *Cataetyx rubrirostris* collected off northern Oregon (Grinols and Greenfield, 1966, p. 212);

8 (4 + 4) in a specimen of *Parabassogigas grandis* (Günther), standard length 127 cm. (CAS 25724), collected some 40 miles west-southwest of Farallon Lighthouse, California, on September 22, 1952, by Warren Beadle and R. G. Hamilton;

8 (4 + 4) in a specimen of *Parabassogigas grandis*, total length 135 cm. (catalog no. 39255 in the Zoological Institute, University of Tokyo), collected February 28, 1938 (?), off Katsu-ura, Wakayama Prefecture (eastern coast of Kii Peninsula), south of Nagoya, Japan.

Ray counts of D. 92, A. 70 taken by Jordan and Evermann (1898b. p. 2502) from a specimen of *Brosmophycis marginata* collected off San Francisco were corrected to D. 100, A. 76 by Gilbert and Thompson (1905, p. 985). Vertebral counts of 16 + 47 = 63, 16 + 48 = 64, 17 + 47 = 64, and 17 + 48 = 65 were noted by Best (1957, p. 98).

Family Ophidiidae—Cusk-eels

Chilara taylori (Girard).

The spotted cusk-eel (see Herald, 1953, figs. 1–3, as *Otophidium taylori*) was originally described from six small specimens, the largest 3¼ inches in

length, taken in "the sands of Monterey Beach," California (Girard, 1858, p. 138, as *Ophidion taylori*).

This species has long been referred to the genus *Otophidium* Gill *in* Jordan (1887, p. 914), but its high vertebral counts indicate that it should be referred instead to the genus *Chilara* Jordan and Evermann (1896, p. 482). The type-species of *Otophidium* (*Genypterus omostigma* Jordan and Gilbert, 1882, p. 301; by original designation) has a relatively low vertebral count (14 + 43 = 57, as determined from a radiograph of the holotype; see Böhlke and Robins, 1959, p. 42). In contrast, the type-species of *Chilara* (*Ophidion taylori,* by original designation) has a high vertebral count (18 + 69 = 87, etc.; see vertebral counts, below). Therefore, on the basis of the vertebral count, the genus *Chilara* appears worthy of recognition. The binomen *Chilara taylori* is well known from the usage of Jordan and Everman (1896, p. 482; 1898b, p. 2489), Starks and Morris (1907, p. 240), and Snyder (1913, p. 460).

Chilara taylori ranges from northern Oregon to San Cristobal Bay, Baja California (Fitch and Lavenberg, 1968, p. 75).

Recorded depths of capture are 1.2 m. (Herald, 1953, p. 381; "4 feet"); 13 m. to 126 m. (Gilbert, 1895, p. 472; "7 to 69 fathoms"); 18 m. or 22 m. (Snyder, 1913, p. 460; "10 or 12 fathoms"); 18 m. to 244 m. or more (Fitch and Lavenberg, 1968, p. 75; "60 to 800 feet or more"); 55 m. (Hubbs, 1916, p. 166).

A specimen of this species has been taken from the stomach of *Sebastes auriculatus* Girard (Hubbs, 1921b, p. 28), and another specimen, about 25 cm. in length, from the stomach of a 115-cm. specimen of *Alepisaurus ferox* Lowe (Roedel and McCully, 1939, p. 35, as *Alepisaurus aesculapius*).

The spotted cusk-eel has been said to reach a length of about 36 cm. (Jordan and Gilbert, 1881, p. 65, as *Ophidium taylori*; "14 inches").

Material. Seven specimens (large young to small adult), standard length 74 mm. to 190 mm., CAS 26765.

Six specimens have each 4 + 5 caudal rays, the articulation of these rays with the hypurals somewhat resembling that in *Ophidion barbatum* Linnaeus (see Whitehouse, 1910, pl. 50, fig. 30, as *Ophidium barbatum*). Four specimens have each a vertebral formula of 18 + 69 = 87; one, 18 + 70 = 88; one, 18 + 71 = 89; and one, 19 + 71 = 90. (Of the specimens noted by Clothier, 1951, p. 79, pl. 23, two had each a total of 87 vertebrae; eight, 88; and one, 89.)

ZONATION

I follow the terminology of Hedgpeth (1957, fig. 1) for the classification of the benthic environment below the littoral (intertidal) zone:

Inner sublittoral, between low water and a depth of about 50 meters;
Outer sublittoral, depths from about 50 to 200 meters;
Bathyal, depths below 200 meters (to about 4000 meters).

Of the seven species represented among the fishes cast ashore near Point Joe, *Sebastes helvomaculatus* is noteworthy as an inhabitant of the bathyal zone, although it has been recorded as well from the outer sublittoral zone; *Sebastes rosaceus* and *Brosmophycis marginata* have been recorded from both the outer and the inner sublittoral zone; *Coryphopterus nicholsii* and *Chilara taylori* are known to range from the outer sublittoral into the littoral (intertidal) zone; *Sebastes flavidus* descends to the lower limits of the outer sublittoral, but a young example, of a size comparable to that of the specimen in this collection, has been taken within the inner sublittoral zone; only *Micrometrus aurora* appears restricted to the littoral (intertidal) zone.

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